

THE NATIONAL ACADEMIES  
DIVISION ON EARTH AND LIFE STUDIES  
BOARD ON EARTH SCIENCES AND RESOURCES

COMMITTEE ON SEISMOLOGY AND GEODYNAMICS

Award Number 08HQGR0146

**Final Technical Report**  
**September 1, 2008 to August 31, 2010**

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**ABSTRACT**

Most of the focus of the Committee on Seismology and Geodynamics (COSG) during the term of this award was on the oversight of three ad hoc study committees—the Committee on *National Requirements for Precision Geodetic Infrastructure*; the Committee on *National Earthquake Resilience—Research, Implementation, and Outreach*; and the Committee on *Grand Challenges in Earthquake Engineering Research—A Vision for NEES Experimental Facilities and Cyberinfrastructure Tools*. In addition, two meetings of the COSG were held during the award period—on November 5-7, 2008, in Irvine/Pasadena, California, and on April 30-May 1<sup>st</sup> 2009, in Washington D.C. The committee intended to hold additional meetings in November, 2009 and on June 21-22, 2010; however, a combination of delayed receipt of funds from committee sponsors, schedule conflicts with IRIS events, and individual committee scheduling issues meant that both these planned meetings were eventually cancelled.

During the November, 2008 meeting, the committee members traveled to the USGS field office in Pasadena and were fortunate to receive a series of extremely useful briefings on the ShakeOut Scenario, ANSS deployment, SCEC, and other USGS activities (see agenda below). Agency visits during earlier COSG meetings were to DOE-Office of Science, the National Science Foundation, and to the National Aeronautics and Space Administration. Following the Pasadena visit, the committee was briefed on the newly released NEHRP Strategic Plan, and then hosted a roundtable discussion on earthquake early warning.

The 2009 meeting was held at the Keck Center facility, and was focused on presentations and commentary from sponsoring agencies—USGS, NSF, NASA, and DOE—concerning their activities and programs (see agenda below). The committee also spent some time discussing whether there might be some role that the committee could play to contribute to agency activities.

With continued support from government agencies, the COSG will be able to provide advice to scientific groups working on seismological and geodynamic issues both inside and outside the federal government.

### STATEMENT OF TASK

The Statement of Task for the COSG is to:

1. Foster and encourage understanding of the structure, dynamics and evolution of the Earth.
2. Review and define basic and applied research activities in seismology, geodesy and geodynamics that contribute to federal agency missions.
3. Address the transfer of seismological and geodynamics knowledge to areas of public welfare and national need including topics such as earthquake science; geological hazards; energy, mineral, and water resources; national security; global climate change; land-use planning; and public education.
4. Foster long-term national efforts to collect, store and openly disseminate seismological, geodetic, and geodynamical data of all types.
5. Foster long-term national efforts to monitor geodynamical events as well as nuclear testing treaties using geophysical technologies.
6. Serve as the U.S. member of the Inter-Union Commission on the Lithosphere.

### COMPLETED ACTIVITY

#### *National Requirements for Precision Geodetic Infrastructure*

The COSG was the oversight body for an ad hoc study to address the following statement of task:

“Improvements in positioning, navigation, and timing have always driven exploration and understanding of our world. Recognizing the national importance of maintaining and improving the global, high precision geodetic infrastructure that is fundamental to scientific discovery and leadership, and their applications to societal well-being and a vast array of commercial activity, an NRC committee will:

- Describe and assess the range of benefits to the nation that are dependent on high precision geodetic networks;
- Review high priority scientific objectives that are dependent on geodetic networks;
- Describe the infrastructure requirements for achieving these objectives and benefits;
- Assess the opportunities for technological innovation that will arise from renewed investment in geodetic infrastructure;
- Recommend a national plan for the implementation of a precision geodetic infrastructure.

No budgetary recommendations will be made.”

Funding for this activity was provided by USGS, NSF-Division of Earth Sciences, NASA, NOAA-National Geodetic Survey, DOD-U.S. Naval Observatory, and DOD-National Geospatial-Intelligence Agency. After a broad call for committee nominations, the study committee was appointed in February 2008. The committee held five meetings—in Washington, D.C. on April 6-8, 2008; in Boulder, CO, on June 11-13, 2008; in Irvine, CA, on September 11-13, 2008; in Austin, TX, on November 19-21, 2008; and in Washington, D.C. on June 17-19, 2009. The study was completed on September 1<sup>st</sup> 2010 with the release of the committee's report "*Precise Geodetic Infrastructure—National Requirements for a Shared Resource*." Since report release there have been extensive briefings at federal agencies in Washington, DC and on the Hill. We would be happy to provide additional copies of this report if required.

## **PRESENT OVERSIGHT ACTIVITY**

### ***National Earthquake Resilience—Research, Implementation, and Outreach***

The COSG is the oversight body for an ad hoc study to address the following statement of task:

"A National Research Council committee will develop a roadmap for earthquake hazard and risk reduction in the United States. The committee will frame the road map around the goals and objectives for achieving national earthquake resilience in public safety and economic security stated in the current strategic plan of the National Earthquake Hazard Reduction Program (NEHRP) submitted to Congress in 2008. This roadmap will be based on an analysis of what will be required to realize the strategic plan's major technical goals for earthquake resilience within 20 years. In particular, the committee will:

- Host a national workshop focused on assessing the basic and applied research, seismic monitoring, knowledge transfer, implementation, education, and outreach activities needed to achieve national earthquake resilience over a twenty year period.
- Estimate program costs, on an annual basis, that will be required to implement the roadmap.
- Describe the future sustained activities, such as earthquake monitoring (both for research and for warning), education, and public outreach, which should continue following the 20 year period."

Funding for this activity has been provided by NIST. After a broad call for committee nominations, the study committee was appointed in February 2009. Committee meetings were held on May 5-7, 2009, at the National Academy of Sciences building in Washington, DC; on August 17-19, 2009, where more than 60 people attended a 2-day community workshop hosted by the committee at the NRC's Beckman Center facility in Irvine, CA, with a follow-up 1-day meeting for report planning; on October 28-30, 2009 at the Hyatt Rosemont Hotel in Chicago; and on December 7-9, 2009 at the NRC's Keck Center facility in Washington, DC. Although delayed by medical and other issues, the

committee completed their study report in November 2010 and, following external review during December 2010, is due for public release before the middle of March, 2011.

***Grand Challenges in Earthquake Engineering Research—A Vision for NEES  
Experimental Facilities and Cyberinfrastructure Tools***

The COSG is the oversight body for an ad hoc study to address the following statement of task:

“The National Science Foundation (NSF) supports the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES), as a component of the National Earthquake Hazards Reduction Program (NEHRP). In FY 2014, NSF will have supported ten years of NEES operations and research, and seeks an evaluation of next-generation U.S. needs for earthquake engineering research beyond 2014. A National Research Council committee will organize a public workshop on the Grand Challenges for earthquake engineering research, to bring together experts to focus on two questions:

- (1) What are the high-priority Grand Challenges in basic earthquake engineering research that require a network of earthquake engineering experimental facilities and cyberinfrastructure?
- (2) What networked earthquake engineering experimental capabilities and cyberinfrastructure tools are required to address these Grand Challenges?

The workshop will feature invited presentations and discussion. The committee will develop the agenda, select and invite speakers and discussants, and moderate the discussion. Workshop participants will be asked to describe the experimental infrastructure capabilities and cyberinfrastructure tools in terms of requirements, rather than by reference to any existing or specifically located future facilities.

In responding to the foregoing questions, workshop participants will also be asked to consider future technical and conceptual advances with the potential to influence future earthquake hazard research, such as early warning systems, new materials, sustainability, high-performance computing and networking, modeling, sensor and monitoring technologies, and other factors identified by the committee. The committee will prepare a report summarizing discussions at the workshop; the report will not include findings or recommendations.”

Funding for this activity has been provided by NSF-ENG. After a broad call for committee nominations, the 7-person workshop steering committee was appointed in October 2010, and the workshop planning meeting will be held on December 6-7, 2010, at the NRC’s Keck Center in Washington, DC. At this meeting, the committee will be briefed by the sponsor, by the NEHRP Director, and by other interested parties. They will then plan the structure and other organizational aspects for the January 25-26, 2011 workshop, to be held at the NRC’s Beckman Center facility in Irvine, CA. The workshop report will be completed and released during spring of 2011.

## MEMBERSHIP OF THE COMMITTEE ON SEISMOLOGY AND GEODYNAMICS

Committee membership during the 2008-2010 period of this award was:

### Present Members:

*Chair* - vacant

**Michael E. Wyession**, *Vice-Chair*, Professor of Geophysics, Department of Earth and Planetary Sciences, Washington University, St. Louis, MO (term expires 12/31/2012).

**J. Ramón Arrowsmith**, Associate Professor of Geology, School of Earth and Space Exploration, Arizona State University, Tempe, AZ (term expires 12/31/2012).

**Emily E. Brodsky**, Associate Professor of Geophysics, Department of Earth and Space Sciences, University of California, Santa Cruz (term expires 12/31/2011).

**James L. Davis**, Lamont Research Professor, Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY (term expires 12/31/2011).

**Stuart Nishenko**, Senior Seismologist, Geosciences Department, Pacific Gas and Electric, San Francisco, CA (term expires 12/31/2011).

**Peter L. Olson**, Professor of Geophysical Fluid Dynamics, Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, MD (term expires 12/31/2012).

**Nancy L. Ross**, Professor of Mineralogy, Department of Geosciences, Virginia Polytechnic Institute and State University, Blacksburg (term expires 12/31/2012).

**Charlotte A. Rowe**, Seismologist, Los Alamos National Laboratory, NM (term expires 12/31/2012).

**David T. Sandwell**, Professor of Geophysics, Scripps Institution of Oceanography, University of California at San Diego (term expires 12/31/2011).

**Brian W. Stump**, Professor of Geological Sciences, Department of Geological Sciences, Southern Methodist University, Dallas, TX (term expires 12/31/2012).

### Former Members (terms expired):

**Terry C. Wallace, Jr.**, *Chair*, Principal Associate Director of Science, Technology, and Engineering, Los Alamos National Laboratory, New Mexico (term expired 12/31/2006).

**Alan Levander**, *Vice-Chair*, Chair of the Department of Geosciences, Rice University, Houston, Texas (term expired 12/31/2006).

**Louise H. Kellogg**, *Chair*, Professor of Geology and Department Chair, University of California, Davis (resigned 12/31/2010).

**Roland Burgmann**, Professor, University of California, Berkeley (term expired 12/31/2005).

**Adam M. Dziewonski**, NAS, Frank B. Baird, Jr. Professor of Science, Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA (term expired 12/31/2008).

- Goran Ekstrom**, Professor, Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA [now Professor of Earth and Environmental Sciences at Columbia University] (term expired 12/31/2003).
- William E. Holt**, Professor, Department of Geosciences, State University of New York at Stony Brook (term expired 12/31/2008).
- Shun-Ichiro Karato**, Professor, Department of Geology and Geophysics, Yale University, New Haven, CT (term expired 12/31/2004).
- Jack R. Murphy**, Chief Scientist, Defense Technology Group, Science Applications International Corporation, Arlington, Virginia (term expired 12/31/2006).
- Guust Nolet**, George J. McGee Professor of Geophysics and Geological Engineering, Department of Geosciences, Princeton University, Princeton, NJ (term expired 12/31/2003).
- Jeffrey J. Park**, Professor, Department of Geology and Geophysics, Yale University, New Haven, CT (term expired 12/31/2002).
- M. Meghan Miller**, UNAVCO, Boulder, CO (term expired 12/31/2009).
- Paul G. Silver**, Staff Scientist, Department of Terrestrial Magnetism, Carnegie Institution of Washington (term expired 12/31/2005).
- Aaron A. Velasco**, Associate Professor, Department of Geological Sciences, University of Texas at El Paso (term expired 12/31/2008).
- Ru-Shan Wu**, Research Geologist, Theoretical Seismology and Geophysical Imaging University of California, Santa Cruz (term expired 12/31/2006).

BOARD ON EARTH SCIENCES AND RESOURCES  
**Committee on Seismology and Geodynamics**  
November 5-7, 2008

**The Arnold and Mabel Beckman Center**  
100 Academy Drive  
Irvine, California  
Balboa Room

**AGENDA**

**Wednesday, November 5, 2008**

**CLOSED SESSION (Committee and staff only)**

8:00 am to 10:00 am

**OPEN SESSION (Open to the public)**

*Visit to USGS Pasadena Field Office*

- 10:30 am    Introductions, overview of Caltech-USGS network operations  
              Overview of Pasadena Earthquake Hazard Team program: Hough  
              Network operations/EWS instrumentation: Given  
              Real-time systems: Hauksson  
              GPS: King
- 11:30 am    Tour of Seismo Lab operations
- 12:00 pm    Lunch
- 1:00 pm    Visit to GPS/laser strain meter site
- 2:15 pm    ShakeOut/Multihazards demonstration project  
              ShakeOut: Jones  
              EWS development: Hudnut, Kanamori
- 3:15 pm    Break
- 3:30 pm    UCERF probabilities report: Field or Felzer
- 4:15 pm    SCEC partnership: Jordan
- 5:00 pm    Discussion
- 5:30 pm    Adjourn

Thursday, November 6, 2008

**OPEN SESSION (Open to the public)**

## NEHRP and Earthquake Early Warning Systems

8.30 am	Welcome Working Breakfast	<i>Louise Kellogg, Chair</i>
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9:00	Opening Remarks and Introductions	<i>Louise Kellogg, Chair</i>
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9:15 NEHRP Strategic Plan *Jack Hayes, NIST/NEHRP*

### User and Implementation Perspectives:

9:45 Earthquake Early Warning: Societal and Public Policy Issues *Jim Goltz*  
*California Office of Emergency Services*

10:15 Earthquake Early Warning for Gas and Electric Utilities: A  
Prospective Users' Perspective *Woody Savage, USGS*

10:45	Break
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11:00	California Real Time Network: Test Bed for Early Warning Systems within a Modern Data Portal Environment	<i>Yehuda Bock, UC San Diego</i>
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### Federal Perspectives:

11:30 USGS's Role in Earthquake Early Warning *Michael Blanpied, USGS*

12:00 pm    NASA's Role in Earthquake Early Warning    *John Rundle, UC Davis*

12:30 Lunch in Beckman Center Dining Room

### Current Research:

1:30	Title TBA	Thomas Heaton, Caltech
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2:00	Title TBA	<i>Richard Allen, UC Berkeley</i>
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2:30	Roundtable Discussion	<i>Committee and Guests</i>
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3:30 Adjourn Open Session

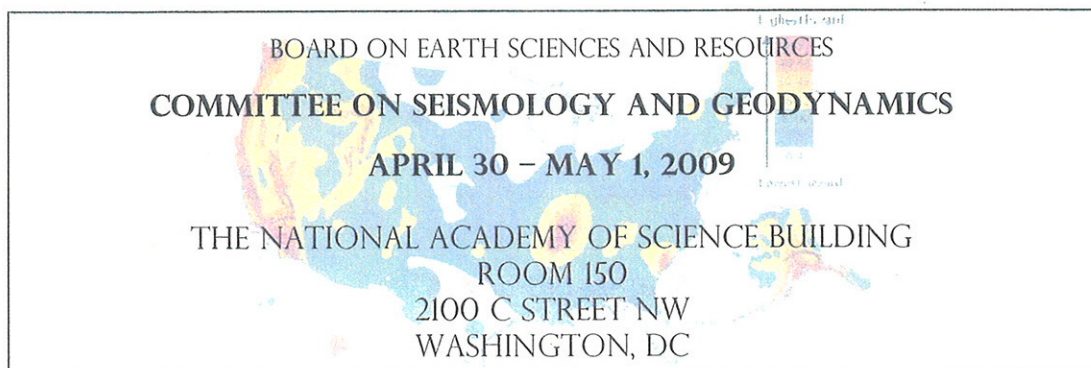
Friday, November 7, 2008

**CLOSED SESSION (Committee and staff only)**

8:30 am to 1:00 pm



Attachment



**Draft Agenda**

**Thursday, April 30, 2009**

**CLOSED SESSION**

**(8.30 am – 12.30 pm: committee and staff only)**

**OPEN SESSION**

**(12.30 pm – 5.15 pm: open to the public)**

12.30 pm	Working Lunch	
1.30	NSF-EAR update	<i>David Lambert</i>
2.00	EarthScope Update	<i>Greg Anderson</i>
2.30	National Aeronautics and Space Administration	<i>John LaBrecque</i>
3.00	Break	
3.30	Department of Energy: Office of Science	<i>Nick Woodward</i>
4:00	U.S. Geological Survey – ANSS Status	<i>William Leith</i>
4:30	CTBT Status and Verification Needs	<i>William Leith</i>
4:45	Committee Discussion – study opportunities	<i>Louise Kellogg</i>
5:15	Adjourn	

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**Friday May 1, 2009**

**CLOSED SESSION**

**(8.30 am – 4.30 pm: committee and staff only)**